What is claimed is:

[c01] 1. A system comprising:

an investment molding cavity;

a seed crystal starter cavity;

a seed crystal for initiating epitaxial crystal growth in molten metallic material that comes into contact therewith;

a grain selector operatively connecting the seed crystal starter cavity and the investment molding cavity for at least one of: (1) selecting a single crystal from the seed crystal to grow into the molten metallic material during solidification, or (2) ensuring that a single crystal from the seed crystal continues to grow into the molten metallic material during solidification; and

a grain selector support for at least partially supporting the weight of the investment molding cavity and any molten metallic material contained therein to take at least a portion of this weight off the grain selector,

wherein the system is capable of producing a single crystal investment cast component.

[c02] 2. The system of claim 1, wherein the seed crystal comprises a single crystal grain structure.

[c03] 3. The system of claim 1, wherein the seed crystal comprises a cross section of at least one of the following shapes: circle, square, rectangle, oval, semicircle, and polygon.

[c04] 4. The system of claim 1, wherein the seed crystal comprises a cross-sectional area of about $0.0007in^2$ to about $0.625in^2$.

[c05] 5. The system of claim 1, wherein the seed crystal comprises a height wherein the top of the seed crystal extends into the furnace far enough that a temperature of the top of the seed crystal exceeds a liquidus temperature of the seed crystal, while a temperature of the bottom of the seed crystal remains below a solidus temperature of the seed crystal.

[c06] 6. The system of claim 1, wherein the seed crystal comprises <001> primary and secondary crystallographic orientations.

[c07] 7. The system of claim 1, wherein the seed crystal comprises a <111> primary orientation and a <112> or a <110> secondary crystallographic orientation.

[c08] 8. The system of claim 1, wherein a secondary orientation of the seed crystal is aligned with a predetermined crystal plane dictated by a casting feature where controlled secondary orientation is desired.

[c09] 9. The system of claim 1, wherein the seed crystal comprises at least one of the following: a nickel-based superalloy, an iron-based superalloy, a cobalt-based superalloy, and a refractory-based superalloy.

[c10] 10. The system of claim 1, wherein the seed crystal comprises at least one of the following alloying elements: cobalt (Co), chromium (Cr), carbon (C), iron (Fe), titanium (Ti), tantalum (Ta), aluminum (Al), molybdenum (Mo), tungsten (W), boron (B), niobium (Nb), zirconium (Zr), hafnium (Hf), yttrium (Y), rhodium (Rh), rhenium (Re), lanthanum (La), manganese (Mn), and silicon (Si), with the balance comprising nominal impurities and at least one of: nickel (Ni), iron (Fe), and cobalt (Co).

[c11] 11. The system of claim 1, wherein the seed crystal comprises about 5 wt. % chromium, about 10 wt. % cobalt, about 5.6 wt. % aluminum, about 1.9 wt. %

molybdenum, about 5.9 wt. % tungsten, about 0.1 wt. % hafnium, about 8.7 wt. % tantalum, and about 3.0 wt. % rhenium, with the balance comprising nickel.

[c12] 12. The system of claim 1, wherein the seed crystal comprises a predetermined melting point such that the molten metallic material that comes into contact therewith melts back a portion of the seed crystal during casting.

[c13] 13. The system of claim 1, further comprising at least two investment molding cavities.

[c14] 14. The system of claim 13, wherein the seed crystal is utilized to grow at least two single crystal investment cast components.

[c15] 15. The system of claim 1, wherein the grain selector comprises a non-linear tubular structure connecting the seed crystal starter cavity to the investment molding cavity.

[c16] 16. The system of claim 15, wherein the non-linear tubular structure comprises at least one of: a helix, a two-dimensional bend, a three-dimensional bend, a staircase, and a zigzag.

[c17] 17. The system of claim 15, wherein the non-linear tubular structure comprises at least one of the following cross-sectional shapes: a circle, an oval, a triangle, a rectangle, a square, and a polygon.

[c18] 18. The system of claim 15, wherein the non-linear tubular structure comprises a passageway therein having a cross-sectional area of about $0.00025in^2$ to about $0.50in^2$.

[c19] 19. The system of claim 15, wherein the non-linear tubular structure comprises a passageway therein having a cross-sectional area no greater than about 1/9 a size of a surface area of a surface of the seed crystal to which the non-linear tubular structure is connected.

[c20] 20. The system of claim 16, wherein the helix comprises about 0.25 to about 10 turns per inch.

[c21] 21. The system of claim 16, wherein the helix comprises about 0.25 to about 10 turns total so that about 90° to about 3600° of rotation occurs from one end of the helix to the other.

[c22] 22. The system of claim 16, wherein an inclination angle of the helix is about 50° +/- 30° from horizontal.

[c23] 23. The system of claim 1, wherein the grain selector support comprises a material capable of providing support to the grain selector up to temperatures of about 3100°F.

[c24] 24. The system of claim 23, wherein the material comprises at least one of: a high strength ceramic, a glass, graphite, and a refractory metal.

[c25] 25. The system of claim 1, wherein the grain selector is positioned about the grain selector support.

[c26] 26. The system of claim 1, wherein the grain selector support comprises a rod with at least one of the following cross-sectional shapes: circular, square, rectangular, triangular, and oval.

[c27] 27. The system of claim 1, wherein the grain selector support comprises a cross-sectional area of about $0.020in^2$ to about $0.25in^2$.

[c28] 28. The system of claim 1, wherein the single crystal investment cast component comprises a gas turbine engine component.

[c29] 29. A system comprising:

a seed crystal;

a grain selector in operable communication with the seed crystal; and

a grain selector support capable of supporting at least a portion of weight bearing on the grain selector,

wherein the system is capable of creating a single crystal investment cast component.

[c30] 30. A method for producing a high performance single crystal investment cast component, the method comprising the steps of:

disposing a seed crystal within a seed crystal starter cavity;

providing a grain selector to operatively connect the seed crystal starter cavity to a mold cavity;

utilizing a grain selector support to support the grain selector, the mold cavity, and any molten metal contained therein;

introducing molten metal into the mold cavity;

allowing the molten metal to flow from the mold cavity, through the grain selector, and into the seed crystal starter cavity;

epitaxially nucleating and growing a single crystal from the seed crystal; and

utilizing the grain selector in conjunction with the seed crystal to grow only a single crystal up into the molten metal in the mold cavity to yield the high performance single crystal investment cast component.

[c31] 31. The method of claim 30, wherein a single seed crystal starter cavity is operatively connected to a plurality of mold cavities.

[c32] 32. The method of claim 30, wherein the seed crystal is utilized to grow at least two single crystal investment cast components.

[c33] 33. The method of claim 30, wherein the high performance single crystal investment cast component comprises a gas turbine engine component.

[c34] 34. The method of claim 30, wherein the grain selector is positioned about the grain selector support.

[c35] 35. The method of claim 34, wherein the grain selector support comprises a rod.